

Empirical Formula Determination- Magnesium Oxide Lab

Purpose: To determine the % Composition & Empirical Formula of Magnesium oxide.

Background: We have been talking about the uses of the formulas of compounds as well as how to determine the simplest (empirical) formula of a compound based on chemical analysis. The purpose of this lab is to put this knowledge to use. During this lab you will start with two separate elements and create a compound. Using the mass of the elements that you begin with and the mass of the final product, you should be able to determine the empirical formula of the compound, magnesium oxide.

In this experiment, the percent composition and empirical formula of magnesium oxide, the main compound that is formed when magnesium metal combines with oxygen in air, will be determined. Heating magnesium in the presence of air causes the metal to ignite and burn- lots of light and heat are given off and a new compound is obtained. According to the law of conservation of mass, the total mass of the products of a chemical reaction must equal the mass of the reactants. In the case of the combustion of magnesium, the following equation must be true:



In both the initial mass of magnesium and the final mass of the magnesium oxide are measured, the increase in mass must correspond to the mass of the oxygen that combined with magnesium. The percent composition and empirical formula of magnesium oxide can then be calculated, based on the combining ratios of magnesium and oxygen in the reaction.

Materials:

- | | | |
|------------------|-------------------------------|--------------------------|
| • Safety goggles | • Clay triangle | • Gas burner |
| • Crucible | • Ring stand | • Centigram balance |
| • Crucible lid | • Ring support crucible tongs | • Magnesium ribbon, (Mg) |

Pre-Lab Questions:

A piece of iron weighting 85.65 g was burned in air. The mass of the iron oxide produced was 118.37 g.

1. Use the law of conservation of mass to calculate the mass of oxygen that reacted with iron.
2. Use the molar mass of oxygen to calculate the number of moles of oxygen atoms in the product.
3. Use the molar mass of iron to convert the mass of iron used to moles
4. Use the ratio between the number of moles of oxygen atoms to calculate the empirical formula of iron oxide.

Safety Precautions:

- Magnesium is a flammable metal. Magnesium burns with an intense flame. Do not look directly at burning magnesium. The light contains ultraviolet light that can hurt your eyes.
- Do not inhale the smoke produced when magnesium is burned.
- Do not loose smoke! The more smoke you loose the more difficult it will be to determine the empirical formula!
- Carefully pre-heat the crucible slowly- if you just throw the crucible on the flame- it will cause the crucible to crack- causing you to lose your data and have to restart!
- Handle the crucible and its lid only with tongs. Do not touch the crucible with fingers or hands. There is a significant burn hazard associated with handling a crucible. Wash hands thoroughly with soap and water before leaving the lab.

Procedure:

1. Set up the equipment according the figure. Clean a crucible and its cover with water. Dry them by heating in the hottest part of the flame for 2 minutes. Be sure it is completely dry before you begin your experiment. Allow them to cool for at least 10 minutes. Measure and record the combined mass of the crucible and lid to the nearest 0.01g.
2. Place a coiled 10 cm length of magnesium ribbon in the crucible. Measure and record the combined mass of the crucible, lid and magnesium.
3. **CAUTION: DO not look directly at the burning magnesium. View the reaction through the film or glass provided by your teacher.**
4. Over a high flam, heat the uncovered crucible on the triangle until the magnesium ignites. **CAUTION: DO not inhale the smoke produced.**
5. When the magnesium begins to burn, immediately cover the crucible (using tongs) and remove the burner. **You do not want to loose smoke- because that means you are loosing Magnesium and it will be more difficult to determine the empirical formula!**
6. After smoke produced has ceased, replace the burner and continue heating the crucible. Remove the burner and carefully lift the lid and check the reaction every 2 or 3 minutes. After heating for a total of 10 minutes, check to see if the reaction is complete. The magnesium should be wholly converted to a light gray powder, magnesium oxide. IF ribbon like material remains in the crucible, replace the burner and continue heating.
7. When you think that you have completed the lab- call Mr. Kracht over to check your product before you completely remove the crucible from the triangle.
8. If time permits, dump the COOL contents of the crucible onto a watch glass. Using a spatula, break up the solid and note the appearance and consistency of the product. Is any magnesium ribbon still present? Record the observation. Dump the contents of the crucible into the Designated waste bin and carefully clean the crucible and crucible lid!
9. Follow Mr. Kracht's instructions for proper diposal and clean up of materials. Get Mr. K's Signature for Clean-up points!

Magnesium Oxide Lab Answer Sheet!

Alpha # _____ Name: _____ Date: _____ Period: _____

Mr. K Signatures 1:

Mr. K Signature 2:

Data Table:

Mass of Crucible and Lid	
Mass of Crucible, Lid and Mg Ribbon	
Mass of Crucible, Lid and Product	

Mass of Magnesium Oxide	
Mass of Magnesium	
Mass of Oxygen	

Observations: _____

Analyses and Conclusions:

Show all work and calculations. Please place all answers in boxes with the appropriate units and significant figures.

1. Determine the mass of magnesium used:
2. Determine the number of moles of magnesium used:
3. Determine the mass of magnesium oxide formed:
4. Determine the mass of oxygen that combined with the magnesium:
5. Calculate the number of moles of oxygen atoms that were used:
6. Calculate the ratio between the moles of magnesium used and the moles of oxygen used. Express this ratio in simplest whole-number form.

7. Based on your experimental data, write the empirical formula for magnesium oxide. After you find the answer to this question- place the results of your empirical formula on the board as class data.

8. Is this the molecular formula or the simplest formula? Explain how you know this. _____

Answer the following two questions after viewing class data.

9. Write a balanced chemical equation for the formation of magnesium oxide from magnesium metal and oxygen gas (a diatomic molecule).

10. Identify major sources of error in this experiment. Explain how the magnesium: oxygen ratio would be affected by each error you identify.

[illegible]

11. Explain what you learned from this lab- try to identify what you discovered and explained how you achieved this information.

[illegible]

